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THE CONDITIONED REFLEX OR CONDITIONED RESPONSE AS A COMMON ACTIVITY OF LIVING ORGANISMS

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Introduction. Yerkes and Morgulis' review of "The Method of Pawlow in Animal Psychology" (**168**) was based principally on six papers by Pawlow, Nicolai, Zelyonîy, and Orbeli, and was written in 1909. Many other experimental reports and general discussions are now available, and the following summary will show that although the scientific study of the conditioned reflex originated in the physiological laboratory of Pawlow, many writers have used it in the study of animal, genetic, human adult, and abnormal psychology. Physiologists classify the conditioned reflex in that large and convenient group of phenomena called psychic, and they frequently refer to it as a psychic or cerebral reflex. Many psychologists still use the physiologists' term "reflex" in referring to this form of behavior. Since the conditioned response principle is now used rather widely in psychology, hygiene and social science, and because of the narrow meaning of the term "reflex" in biology, it seems desirable to use the term "response" in the place of "reflex." The term "response" does not exclude the reflexes, and it has the advantage of including many forms of behavior which are not strictly "reflex" in nature. However, in many cases it makes very little difference whether the activity in question can be properly called "reflex" or not. We shall use "C-R" as an abbreviation for conditioned response in this review.

The C-R principle does not necessarily have a mechanistic or behavioristic connotation. Although much of the experimental work which we shall summarize is a flat contradiction of vitalistic fancies and purposive psychology, it should be noted that the C-R principle does not exclude introspection or even structuralism. It deserves to be considered in the same class with memory, emotion, etc., simply as a good subject for psychological investigation. The C-R was clearly discussed by Locke and others as a part of the associationists' problem, and it resembles many other phases of modern science and philosophy in being an old concept. It has played a part in directing attention to the stimulus-response idea in association as opposed to a connection between two ideas or between two external objects. It is a significant fact that as far as the C-R principle is concerned the signs of structural psychology and behavior psychology now point in the same direction, just as one would expect in a monistic world. (**32, 33**)

Historical. Locke gave a foreshadowing of the C-R rule in his "*Essay Concerning Human Understanding.*" (**96**) In the last chapter of Book 2, on the "association of ideas," he gives several examples of C-R's in describing the acquisition of everyday antipathies and aversions, and a broad application of the concept is made. "Instances of this kind," Locke writes, "are so plentiful everywhere, that if I add one more, it is only for the pleasant oddness of it. It is of a young gentleman, who having learned to dance, and that to great perfection, there happened to stand an old trunk in the room where he learned. The idea of this remarkable piece of household stuff had so mixed itself with the turns and steps of all his dances, that though in that chamber he could dance excellently well, yet it was only whilst that trunk was there; nor could be perform well in any other place unless that or some such other trunk has its due position in the room." In Book 3, ch. 9, Locke carries the same explanatory principle to the language mechanism: "If we will observe how children learn languages, we shall find that to make them understand what the names of simple ideas, or substances, stand for, people ordinarily show them the thing whereof they would have them have the idea; and then repeat to them the name that stands for it, as white, sweet, milk, sugar, cat, dog." Thus in 1690 we see that the idea of "conditioning" was important and commonplace; to-day it seems to be important because it is commonplace. Locke's theory of association was complicated by his views on "reflection,"

now long since discarded, and he considered that the involuntary association of ideas was a " disease of the understanding."

Although Leibnitz's *" New Essays "* were forced into a philosophical system, he had a friendly attitude towards Locke's statements concerning the C-R principle. " This remark," he comments, " is important and wholly to my taste, and can be fortified by an infinite number of examples. Descartes having had in his youth some affection for a squint-eyed person, could not prevent himself from having all his life an inclination towards those who had this defect." (**95**, pp. 281–284) Cousin was another able critic of Locke; and even with his spiritualistic keynote he stated in 1829 that " he [Locke] has shown by a multiude of examples how it frequently happens that, simply because we have seen two things by chance united, this purely accidental association subsists in the imagination and perverts the understanding. This is a source of a multitude of errors, not only of false ideas, but of false sentiments, of arbitrary antipathies and sympathies, which not unfrequently degenerate into insanity [*sic*]. We find here in Locke the wisest councils for the education of the soul and of the mind. . . . This whole chapter [on the association of ideas] shows the ingenious observer, and the true philosopher. . . ." (**38**, pp. 128–130) In 1794 Erasmus Darwin wrote that " all the fibrous motions, whether muscular or sensual, which are frequently brought into action together, either in combined tribes, or in successive trains, become so connected by habit, that when one of them is reproduced the others have a tendency to succeed or accompany it." (**41**, p. 34)

There is a close resemblance between the C-R and the " law of contiguity " as some writers state it. James' formulation will serve as an illustration: " When two elementary brain-processes have been active together or in immediate succession, one of them, on recurring, tends to propagate its excitement into the other." (**66**, p. 566) A few writers still refer to contiguity as *the* law of association and learning. Basing his views on some very extensive work in the fields of comparative physiology and comparative psychology, Loeb concluded that the most important problem in the physiology of the central nervous system was the function of an elementary process called associative memory.(**97**, pp. 213–234) We recognize the C-R mechanism in his definition of this process: " By associative memory I mean that mechanism by which a stimulus brings about not only the effects which its nature and the specific structure of the irritable organ call for, but by which it brings about also the effects of other

stimuli which formerly acted upon the organism almost or quite simultaneously with the stimulus in question." (**97**, p. 12) Loeb believed that associative memory could modify any of the reflex and instinctive motor processes in man. As late as 1918 Loeb once more stated the C-R principle in the same way in his definition of associative memory.(**98**, pp. 164–172) He also held that all psychic phenomena are functions of associative memory,(**99**, pp. 235–244) and that " the criteria for the existence of associative memory must form the basis of a future comparative psychology." (**98**, p. 218)

The Pawlow School. While it has been known for some time that various stimuli may affect the digestive system, it remained for Pawlow[1] to demonstrate the very close connection between the activity of the secretory glands in the stomach of the dog and the nervous impulses coming from the head region.(**151**, **120**, **125**, **122**) His work on conditioned salivary reflexes in the dog grew out of this larger problem.(**4**, **128**) Pawlow was awarded the Nobel prize in medicine in 1904, which date practically marks the beginning of his study of conditioned reflexes.(**64**) Most of the experiments were carried out in a very well-equipped laboratory.(**127**, **129**, **111**) The dog's salivary glands were found to be well suited to this kind of study, because they function readily and the saliva can be measured quantitatively. Since it was found that any stimulus affecting the dog can be associated with the flow of saliva,(**65**) and since many changes in the activity of the nervous system affect the salivary glands, and also because some external cause can be recognized every time the saliva flows, Pawlow decided to make an extensive investigation of the functions of the central nervous system by this method. A mass of information has been obtained in this way about the psychology of the dog.(**121**, **124**, **171**, **123**, **55**)

Pawlow is interested in the responses of animals to external conditions, and he believes that these responses include all of the higher mental processes in the dog as well as in man. He objects strenuously to explanations in terms of " psychology," and wishes " to restore to physiology what properly belongs to it." (**123**, p. 614; **105**) His argument runs that since psychology is not yet an " exact " science, *physiology* can gain nothing from it! (**130**, p. 973) Pawlow believes that he has been justified in introducing the idea of conditioned reflexes in physiology, because it is a direct inference from the experimental facts. For him the C-R is an elementary process.

[1] Sometimes spelled " Pavlov," " Pavlow," or " Pavloff."

Most of the animals used by Pawlow belonged to a healthy mixed race of hunting dogs, having a copious flow of saliva. Acid, meat powder and sugar, etc., were used for the "unconditioned" stimuli. The conditioned stimulus may be given a short time before, or with, the unconditioned stimulus, but if it is given after the unconditioned stimulus no salivary reflex will take place. This is due to the highly complicated process called "inhibition." (**129, 130, 126, 131**) Pawlow distinguishes the various inhibitions of drowsiness or sleep, external inhibition, and internal inhibition. A physiological explanation of sleep and hypnosis is offered in terms of inhibition. (**132, 130, 142**) After a C-R has been established, continued repetition of the conditioned stimulus will cause it to degenerate, this being the result of the mechanism of "internal inhibition." The mechanism here is the same as that of "negative adaptation" for an unconditioned stimulus—repetition of the stimulus wears out the response. After the "internal inhibition" has functioned, it has been observed that if any strong neutral stimulus affects the dog, the inhibition itself is arrested, producing an "inhibition of an inhibition," and a copious flow of saliva will result. (**129, 117**) Pawlow thus regards inhibition as an active process. (**43**, pp. 64–85; **144**) He has given a restatement of his views on this subject as late as 1923. (**135**)

Pawlow has worked out a complicated theory of the functioning of the central nervous system based mostly on experimental work. (**130, 123, 126, 111**) The higher activities of the nervous system are explained by the work of two mechanisms—the conditioned reflex and the "analyzer." The analyzers are conceived as "specialized parts of the central nervous system, in each of which we must include the peripheral end-organ of the so-called sense organs, the nerve fiber belonging to it, and its termination in the cells of the cerebral hemispheres." (**130**, p. 974) The function of the analyzers is to analyze the particular phenomena of the external world to which the animal responds, and "pick out from them certain special components." This analysis "lies in very close relationship to the formation of new reflexes." The effect of destroying certain parts of the cerebral hemispheres on the functioning of the conditioned reflexes and analyzers has also been studied. (**130, 176, 169**) Investigations on cerebral physiology by the C-R method have been reported by Pawlow as late as 1921, (**134, 133**) and he discussed the excitability of the brain cortex in 1923. (**137**)

Although Loeb has claimed that Pawlow's method of studying associative memory is the only one which satisfies the demands of

quantitative science,(98, p. 165) we cannot avoid the feeling that Pawlow draws too many conclusions from his experiments. Very little is said about the reliability of the results. Pawlow does not seem to be very well acquainted with the researches of animal psychologists in this country, and the value of his work would also have been increased if he had not limited himself almost entirely to the study of the salivary reflexes of the dog. Watson has pointed out that the conditioned salivary reflex method cannot be used on most of the lower animals.(155, pp. 67, 68)

It is impossible to separate Pawlow's work from that of his students. Zelyoniy [2] has studied the auditory reactions of the dog,(172, 173, 174) and his dissertation (172) has been summarized by Yerkes and Morgulis.(168) Zelyoniy claims that the dogs he used could distinguish between separate sounds which differed from one another by only a quarter of a tone, and that the dog may remember this differentiation for two months. Some specificity was also claimed for the quality of sounds. Bielakoff established conditioned salivary reflexes in the dog to sound and movement. He claims that the dog can differentiate one-eighth of a tone.(15; 43, pp. 33–40) Morgulis (110) has summarized a paper by Usiyevich,(154) who tested the dog's ability to differentiate time intervals between sounds. Usiyevich concluded that the dog could distinguish between 96 and 100 beats of a metronome per minute. Memory for this differentiation was very good after one hour, but disappeared after forty-five hours. Anrep (2) obtained differentiations between 637 and 680 vibrations per second in one dog. His experiment was apparently well controlled.

Orbeli studied conditioned salivary reflexes resulting from optical stimulation of the dog.(118, 143, 168) The visual analyzers were found to be considerably less efficient than the auditory. Some evidence was obtained which apparently indicated that the dog is sensitive to changes in intensity of light, but not sensitive to changes in wave-length. Orbeli also concluded that nervous tissue will respond more actively to an intermittent light stimulus than to a continuous one.

Kasherininova (78) made a study of the tactile analyzer of the dog, and found that it possessed a high degree of specificity. Anrep also reports an investigation in which the salivary reflexes of the dog were associated with cutaneous stimulation.(3) Each of the three

[2] Sometimes spelled "Zeljony," "Zéliony," or "Selionyi."

dogs which Anrep experimented upon had a permanent fistula of the parotid salivary gland. "The degree of irradiation of tactile conditioned reflexes," Anrep says, "depends on the length of the pause between the conditioned and the unconditioned stimulus."

In contrast with Pawlow's point of view, Nicolai used the conditioned salivary reflex method in attempting to study the mental reactions of the dog.(115, 116) The graphic method of measuring the flow of saliva was introduced by him in Germany. By the use of this method the experimenter can leave the room while the experiment is in progress. Nicolai, like Orbeli, believes that the dog does not respond to differences in the wave-length of light.(115)

Experiments on the removal of certain portions of the dog's brain have convinced several of Pawlow's students that conditioned salivary reflexes depend upon the functional activity of the cerebrum. Some of Bechtereff's students did not reach the same conclusions. Following up this work, Toropoff (152) attempted to locate more definitely the anatomical basis of the conditioned reflex arc. His work is in a sense an affirmation of the theories of cortical localization."

Dontchef has criticized the "physiological" point of view adhered to by Pawlow and most of his colleagues.(43) In the first part of her book she gives a brief survey of the work of the Russian school up to 1914. Then she interprets Pawlow's work on dogs in terms of images and affective elements, from the point of view of the Paris school of psychology. She discusses the experiments of Zelyoniy and Orbeli in particular.

The interpretations which have been made of Pawlow's work show that the celebrated Russian scientist has not always been clear in stating his views. Bayliss has given a summary of Pawlow's general work in physiology,(6) and also a more detailed account of his work on C-R's.(7) Bohn stressed and probably overemphasized Pawlow's C-R method as compared with other methods in animal psychology.(18, p. 158) Mitchell gives a general treatment of Pawlow's work on C-R's,(109) and Halliburton appraises it from the chemical point of view.(50) Myerson attempted to evaluate some of Pawlow's general articles on the C-R.(114) Paton discusses Pawlow's work in connection with the general question of the modifiability of reflexes.(119)

Conditioned Responses in Lower Animals Other Than Conditioned Salivary Responses in the Dog. Metalnikoff concluded from his work on protozoa that it was possible to establish "conditioned reflexes" in one-celled animals,(106, 107) but his experiments were

not conclusive. Thompson (150) used the C-R method in making an analysis of the learning process in the snail, *Physa gyrina* Say. Pressure of a piece of lettuce in the region of the mouth of this animal will generally cause a chewing movement of the mouth parts, but this movement is not ordinarily evoked by pressure on the foot. In this experiment, pressure was repeatedly applied to the mouth, causing a movement of the mouth parts, and, simultaneously with this stimulus and this response, pressure was also applied to the foot at a fixed distance from the mouth. This training resulted in the formation of an association between pressure on the foot and a chewing movement of the mouth. Memory for this conditioned chewing reaction persisted for four days. Thompson also tested the snail's ability to learn some very simple labyrinths, but found no reliable evidence that he could learn them.

Westerfield used the C-R method in studying the ability of nine mudminnows (*Umbia limi*) to form associations with sounds.(165) The minnows were able to distinguish between 288 and 426 vibrations per second on a ukelele. The low tone was associated with food and the high tone with a distasteful flavor. McDonald used the same general method, and found that blunt-nosed minnows (*Pimephales notatus*) could form associations with sound vibrations made by a bass viol string.(103) These investigators did not determine whether the vibrations affected the minnows through the skin, the lateral line, the inner ear, or by some combination of these receptors.

Watson established conditioned motor reactions in a dog and in several chickens.(156) The reflex withdrawal movement of the dog's foot, evoked by an electric shock at first, was later associated with a sound. In another form of procedure, Watson obtained a differential reaction to two bells after four experiments lasting twenty minutes each. C-R's were also obtained in the respiratory curves of six out of seven chickens. In the same paper Watson discusses the use which may be made of the C-R method in animal psychology.

Kalischer trained dogs to take food when one sound was given and to refrain from taking it when other sounds were given.(69, 70, 141, 149) He trained the dogs by giving them the food when one sound stimulus was present, and by withholding it when other sounds were present. In some respects this method seems preferable to the salivary reflex method. Some of Kalischer's extirpation experiments seemed to indicate that subcortical centers are directly concerned in

the memory for simple reactions,(**69**) a conclusion, however, which does not agree with the work of the Pawlow school, nor with the more recent work of Lashley on rats.(**93**) Johnson (**68**) criticized the experiments of Kalischer (**69, 70**) and Zelyoniy (**172**) on pitch discrimination in the dog. He claims that Kalischer did not control rhythm, duration of the stimulus, and other disturbing factors. Johnson's work is in turn criticized by Anrep,(**2**) who seems to have also carried out a very careful experiment.

Herrick used the C-R method to form an association in a dog between the stimulus of a flock of sheep and the response of running home.(**53**, p. 67) Zelyoniy (**175**) made a brief study of the motor reactions of a kitten by the C-R method, and claimed that the kitten could distinguish between sounds which differed by only half a tone. The conditions of the experiment, however, throw some doubt upon this conclusion. The C-R method has been used extensively in the training of wild animals, and Bostock's book on this subject shows that the behavior of tigers and other wild animals frequently illustrates the C-R principle.(**20**) The animals' performance in a show is apparently conditioned to various elements in the situation.

A short article recently appeared in *Science* (**136**) in which Pawlow reports the results of an investigation on the inheritance of acquired characters. He says: "The latest experiments (which are not yet finished) show that the conditioned reflexes, *i.e.*, the highest nervous activity, are inherited. At present some experiments on white mice have been completed. Conditioned reflexes to electric bells are formed, so that animals are trained to run to their feeding place on the ringing of the bell. The following results have been obtained: The first generation of white mice required 300 lessons. . . . The second generation required, for the same result, only 100 lessons. The third generation learned to do it after 30 lessons. The fourth generation required only 10 lessons. The last generation which I saw before leaving Petrograd learned the lesson after 5 repetitions. The sixth generation will be tested after my return. I think it very probable that after some time a new generation of mice will run to the feeding place on hearing the bell with no previous lesson." (**136**, pp. 360, 361)

May and Larson (**102**) used Kalischer's C-R method in a study of posture-sense conduction paths in the spinal cord. They trained three dogs to accept food when the right hind leg was rigidly extended and to refuse food when the same foot was in any other

position. Lang and Olmsted (89) used the C-R method described by Watson (156) in a further study of pathways in the spinal cord. They state that " a conditioned reflex to pain involving the left hind leg in dogs was abolished by hemisecting the cord at the level of the first lumbar vertebra on the side opposite to the trained leg. The reflex could be reëstablished after a comparatively long period of training, although the sensation of pain was apparently absent. . . . The reëstablished conditioned reflex was abolished by a second hemisection of the cord on the opposite side several segments nearer the brain. . . ." (89, p. 611) Baer gives considerable evidence to show that C-R's may be established in a dog by direct electrical stimulation of the cortex.(5) Martin and others (100) studied the effects of tactile, auditory, and thermal stimulation on the vasomotor reflexes of normal, decerebrate, and narcotized rabbits. They concluded that the vasoconstriction following mild stimulation was a secondary effect caused by psychic excitation. As long ago as 1852 Bidder and Schmidt described the secretion of gastric juice in a dog at the mere sight of food.(14) Pawlow refers to the same phenomenon in his book on the digestive glands.(125)

Conditioned Responses in Children. In 1917 Watson and Morgan advanced the theory that the original emotional patterns were few, and that the wide range of stimuli which could later call out fear, rage, and love was made possible by conditioned reflex factors.(157) In 1920 Watson and Rayner submitted this matter to an experimental test.(158) One healthy baby was used in the experiments. When the child was eleven months old it was found that he had no fear of a rat but was definitely afraid of a loud noise. Only seven combined stimulations of the loud noise and the rat were required to condition the child's fear response to the rat. Five days later it was found that the child was not afraid of certain objects about the same room, such as blocks, but he was afraid of the rat, and also showed some fear of a rabbit, dog, and seal fur coat. Other variations of the experiment showed that conditioned emotional reactions can be easily established and that they may persist for at least one month. Watson's view is that they persist throughout life and continue to influence personality. Some evidence was also obtained indicating that fear is as primal a factor as love (sex in Freudian terminology). Watson has also sketched an experimental program for the study of infant psychology.(159) Skerritt described a fear reaction in a baby seven and a third months old conditioned to the odor of a rose.(145)

Bogen reported an investigation in which he claims he was able to establish a C-R between a sound and the flow of gastric juice in a child three and a half years old.(**17**)

The treatment of the C-R in the 1924 edition of Watson's "Psychology" (**161**) is substantially the same as in the first edition except that the conditioned emotion experiment just referred to is included. Watson discusses C-R's in glandular activity and in language, and the general use of the C-R method in psychology. The following statement shows that habit and the C-R do not mean exactly the same thing: "Undoubtedly just after birth conditioned reflexes begin to form with respect to the attendants and parents long before systematized habits begin to form. In other words, there is a genuine conditioned reflex level of functioning lying between the reflex-instinct level and the organized habit level." (**161**, p. 280) Watson considers the C-R mechanism in his observations on "The Unverbalized in Human Behavior," (**160**) and in his discussion of thinking.(**162**) Brown has also discussed the relation between the C-R principle and language.(**21**)

Krasnogorski made one of the pioneer studies of young children with the C-R method. In 1907 he reported some observations on the formation of C-R's in a fourteen-month-old baby, who made movements of the mouth at the sight of milk, and later, although somewhat irregularly, when a bell stimulus was present. In 1909 Krasnogorski described an improved C-R method which he used in studying mostly six-year-old children.(**86**, **40**, **63**, **112**) He associated feeding movements with various arbitrary stimuli. Further results given in 1913 (**87**) showed that the C-R method has a wide applicability in the study of young children. Beginning especially in the second year, the feeding reaction of the child can apparently be associated with most any stimulus. Krasnogorski studied the analyzing mechanisms, together with the inhibition and memory, for these C-R's. He also made a comparison between children and dogs, and discussed the question of cortical control.

Mateer has given a critical evaluation of Krasnogorski's technique, and with an improved C-R procedure made a very thorough investigation of sixty-seven children.(**101**) Her work is in large measure a verification of Krasnogorski's claims for this method. She established conditioned feeding movements to tactile stimuli in children varying in age from twelve to eighty-nine months. The children were given several mental and physical tests, and numerous cor-

relations were obtained. A comparison was also made with defectives. Feldman (45) gives a general discussion of Krasnogorski's work (87) and the C-R mechanisms in children.

Burnham pointed out in 1916 that C-R's may be developed in connection with posture,(22) and he has also contributed a very important discussion on the relation between the C-R and the hygiene of school children.(24) He gives many examples of everyday C-R's, and his practical suggestions for improving hygienic conditions should prove very useful. In another paper (25) Burnham suggests that "many important educational and hygienic subjects are most clearly understood and perhaps most profitably investigated from the point of view and by the method of the conditioned reflex." In this paper Burnham also gives a treatment of association and inhibition with particular reference to the child. The basic psychological phenomenon for "*The Normal Mind*" (26) by Burnham is the C-R principle. In the preface of this book Burnham states that "he is not concerned with the conditioned reflex as the basis of any theory of psychology, but recognizes it as an objective method of such significance for the study of children and mentally disordered adults that, without a knowledge of it, the mental hygiene of to-day cannot be adequately understood." He considers habits roughly as systems of conditioned reflexes: "The line of distinction between habits and conditioned reflexes is not clearly marked. Although habits are systems of conditioned reflexes, theoretically all conditioned reflexes are potential habits. Strictly, habits are conditioned reflexes at the outset." (26, p. 171) Burnham's book gives a fairly complete discussion of the relation between child psychology and the C-R principle.

Conditioned Responses in Adults. The writer carried out an experiment in which the pupillary reaction was conditioned to various external stimuli.(29) A change in the intensity of light falling on the retina was used to evoke the natural pupillary response. By ringing a bell repeatedly with a contraction of the pupil the bell itself became an adequate stimulus to cause pupillary contraction in the case of four different subjects. A dilatation of the pupil was associated to the bell stimulus in four other subjects. Another subject was trained so that his pupil would contract for a bell but dilate when a buzzing sound was made in a telephone receiver. An electric shock was also associated with a contraction of the pupil, and, later in the same subject, an association was formed between the shock and a dilatation of the pupil. Memory for these conditioned reflexes per-

sisted for only a short time. Evidence was obtained against the formation of associations in the backward direction (**34**) and against the view that learning is always mediated by consciousness.

In a later experiment, the writer established conditioned eyelid reflexes to a sound stimulus.(**30, 31**) Natural wink reflexes were evoked by the electrical stimulation method, and simultaneously with these a sound stimulus of low intensity was repeatedly given. It was found later that the sound alone would cause the eyelid reflex. The time measures of these responses indicated that the time taken for the conditioned eyelid reactions was faster than could be obtained if the subject winks voluntarily as quickly as possible. Introspections on these C-R's also showed that the subject was not conscious of winking until after he had winked. When the combined stimulation of shock and sound had been repeatedly given, it was observed that the sound had more of a speeding up and regulating effect on the eyelid reflex than at the beginning of the experiment. Further evidence was obtained against the alleged dependence of C-R's on conscious behavior. This experiment, as well as the former one on the pupillary reflex, seems to emphasize the reflex nature of the human organism, and they suggest a form of association and learning which can only be explained by postulating the C-R principle.(**32, 33**)

The first laboratory experiment on the C-R seems to have been carried out by Twitmyer in 1902.(**153**) In the course of a study of the knee-jerk reflex a bell stimulus had been repeatedly given simultaneously with a blow on the knee. During the adjustment of the apparatus for one subject it happened that the bell stimulus was given without the usual blow on the knee, and a kick of the foot took place which in all respects resembled a true reflex. Further investigation confirmed the conclusion that the knee-jerk reflex had been associated with the tap on the bell. The kinesthetic sensations resulting from this involuntary movement were the same as those caused by the more common knee-jerk reflex and the objective tracings were likewise the same.

Dodge carried out an experiment in which knee jerks and lid reflexes were evoked simultaneously a large number of times.(**42**) Dodge was unable to condition the knee-jerk reflex to the lid reflex stimulus. "The lid-reflex," he says, "was somewhat less refractory to experimental reconditioning. It was possible to produce a lid reflex of an approximately normal latency by a knee-jerk stimulus, after a considerable number of simultaneous excitations. Partial

cortical resystematization occurred in the memory experiments after a single repetition of the series." (**42**, p. 268) Cytovitch gives a brief description of an experiment on ten persons in which vasomotor reactions were conditioned to a sound stimulus.(**39**) The right hand was placed in the plethysmograph.

In the "*Objective Psychology*" (**10**, **84**, **9**) von Bechtereff gives a brief summary of several experiments on conditioned motor reactions. He had previously pointed out several advantages of working with conditioned motor reactions,(**8**) and he argues again that Pawlow's conditioned salivary reflex method is too limited in its application. Bechtereff states that "La production simultanée de deux impressions permettait de constater qu'au bout d'un certain nombre de répétitions le réflexe qui normalement ne répondait qu'á une seule, se produisait aussi en réponse a l'autre." His most typical experiment is referred to as follows: "Après un certain nombre de productions simultanées, on avait vu que le mouvement réflexe de la jambe se produisait aussi bien sur l'illumination de la lampe à incandescence ou sur la production d'une note musicale qu'en réponse au contact électrique." (**10**, p. 155) Bechtereff believes that these C-R's are involuntary. There is a general summary of the work which has been done in his laboratory on both motor and salivary reflexes, as well as a discussion of Pawlow's school.(**10**, pp. 249–267) In 1916 Bechtereff gave a special discussion of the localization of C-R's in the brain,(**11**) and in 1923 a discussion of cortex function by associative motor reflexes.(**12**)

A few months ago Bechtereff sent the writer a copy of a more recent work on reflexology, published under the new régime in Russia.(**13**) He seems to realize now that his earlier psychological writings were rather severe, and the new Russian book is called "*The General Principles of the Reflexology of Man, a Textbook of the Objective Biological Study of Personality.*" This work, however, shows Bechtereff more objective than ever. He says that he has now dissolved some of his former difficulties with "psychology," and does not care to use the term any longer in the title of his book. His principal interest at the present time is to establish a new science of reflexology. In the new book there is a lengthy treatment of the relation of the C-R principle to sense physiology, the psychology of learning, Freudian psychology, and personality in general. He continues to use the expression "associated reflexes" for "conditioned reflexes."

Kostyleff carried Pawlow's and Bechtereff's work on C-R's to an even higher theoretical development, and he claims that their work has provided an organic foundation for conscious behavior.(**82, 83**) The Russian experiments on C-R's is the point of departure for his essay on the "*Cerebral Mechanism of Thought.*" (**85**) Kostyleff also points out many of the limitations of Pawlow's generalizations. He is a close follower and an ardent admirer of Bechtereff's "*Objective Psychology,*" which he translated into French.

Regardless of the value of Bechtereff's theoretical assumptions, one hesitates to accept all of his experimental data on the C-R because so little is said about the experimental procedure and the reliability of the conclusions. The laboratory reports of experiments on conditioned motor reactions seem to indicate that they frequently occur in a rather halting fashion. Watson has described a technique for obtaining conditioned motor reactions in man.(**156**) The results obtained with a jerk of the foot to an electric shock were not as satisfactory as those obtained with a withdrawal movement of the finger. Conditioned motor reflexes were obtained in several subjects. Watson also discusses the general characteristics of C-R's and the method of using them to obtain differential reactions, suggesting that this method has some advantages over the "discrimination method" in "deaf and dumb individuals, aphasics, and dementia praecox patients of the 'shut in' type."

Hamel devised an experiment with the purpose of obtaining some evidence in support of his previous conviction that conscious factors mediate C-R's.(**51**) We regret to say that Hamel was not acquainted with what had already been written on the C-R. His procedure is faulty, and there are too many conclusions. He also argues that since conscious processes and C-R's are both mediated by the brain, therefore C-R's are mediated by consciousness! Some other conclusion would have been just as good. Hamel does not seem to know that some reflexes are slow, and that we may be conscious of them. The writer made several attempts to obtain C-R's with the withdrawal movement of the hand, and the objective results agree more closely with Watson (**156**) than with Hamel.(**51**) Although there are too many irregularities in this form of behavior to warrant the continued use of the term "reflex," we obtained some reactions which were not strictly "voluntary."

Wilson had ten subjects learn several series of nonsense syllables, and other subjects copied a list of letters on a typewriter.(**146,**

p. 112) The subjects were later tested under the same and under different conditions; and the superior performance under similar conditions was attributed to the influence of conditioning stimuli.

Various investigations have been made of the "appetite" or "psychic" secretion in man at the sight of food, which illustrate the truth of the old proverb, "Better a dinner of herbs where love is than a stalled ox and hatred therewith." Cannon gave a very suggestive discussion of this matter in 1909,(27) where reference is made to several earlier studies. The failure of Zebrowski (170) and Babkin (4) to obtain conclusive evidence for conditioned salivary reactions seems to have been due partly to faulty technique. Gley and Mendelssohn (49) failed to establish a conditioned salivary reflex in a soldier who had been wounded a short time previously in his right cheek. They found it difficult "to conceive of the production of 'conditioned reflexes' without the intervention of psychic elements." However, their attempts were brief and their patient was abnormal. Lashley made a very careful study of the human salivary reflex,(90, 91) and devised a drainage tube to collect the secretion from Stenson's duct,(90), which has since been slightly improved by Richter and Wada.(140) Lashley reports some conditioned salivary reflexes in man (90) which had been previously established. It is our opinion that it is more difficult to establish conditioned salivary reflexes in a man than in a dog because the man analyzes the situation and cannot be "deceived" so easily. Lashley also made a study of the secretion of the parotid gland in nine patients who were suffering from more or less fully developed hemiparesis or hemiplegia.(92) No conclusive evidence was found in these cases for the existence of conditioned salivary reflexes.

Miller and others have investigated the influence of various factors on the flow of gastric juice in man; (108) and contrary to the view of Carleson they found that several "psychic" factors had an influence. Pawlow says that "appetite spells gastric juice." (125) Cannon's work on the emotions suggests the possibility of establishing C-R's in the adrenal glands.(28)

The Conditioned Response and the Psychology of Learning. The first systematic treatment of the C-R principle from the standpoint of "pure" psychology was given by Smith and Guthrie.(146) These authors make use of the C-R in explaining association, various forms of learning, and imitation. An excellent discussion is also given of its relation to different forms of perception and to elementary social

reactions. Following Smith and Guthrie, Wilson criticized various forms of "trial and error" learning.(166) Hunter has a friendly attitude towards the term conditioned reflex, but believes that undue novelty has been attached to the method.(62) He uses the C-R principle in his discussion of habit formation and association learning. Givler states that the mechanism by which associations are formed is the conditioned reflex, and that the C-R principle underlies habit, memory, and thinking.(48) Humphrey discusses the C-R in a general way in connection with learning, language habits, feeling, and emotion.(61) Woodworth considers that the C-R is important in human and animal learning, and several diagrams are given to show its relation to the law of combination.(167) He speaks of the conditioned reflex as a "type of learning." Strong uses the expression "stimulus substitution" for conditioned reflex in describing the learning processes involved in committing a vocabulary to memory.(148, pp. 74–81) Dunlap applies the term "drainage" to the neural processes involved in the formation of C-R's, and points out some objections to the term conditioned reflex.(44)

McDougall takes a rather facetious attitude towards the whole idea of conditioned reflexes.(104) He says the brain is not concerned with reflexes, and that to demonstrate conditioned reflexes it will therefore be necessary to establish them in animals which have no brain. He gives the credit for elaborating reflexes and conditioned reflexes to the Englishman, Herbert Spencer. The writer has attempted to answer briefly some of Professor McDougall's statements.(35) Mursell raises objections to the C-R as an explanatory principle of learning.(113) Gates makes considerable use of the C-R, but attempts to evaporate the term in favor of the Law of Exercise.(47) Frank attempted to show in a short article that the C-R principle underlies all forms of learning.(46) Peterson answers somewhat irritably that Frank's suggestion is too simple, and that it does not account for the elimination of wrong acts.(138)

Allport describes the way the C-R mechanism operates in modifying the prepotent reflexes with which the child is endowed at birth.(1) Much experimental and observational material is given to show how the fundamental habits are formed. Allport describes the operation of the C-R in emotional experiences, language and gesture, Freudian mechanisms, and in social control. His book on "*Social Psychology*" gives the most extended application of this principle to social reactions. Humphrey has given a very clear exposition of

imitation,(57) and claims that it is "a learned reaction, consisting of activity based upon conditioned reflexes where the secondary stimulus and the reaction are identical." In a later article Humphrey uses the C-R in explaining some simple forms of social reaction.(60) He claims that habits are "chains of C-R's." The writer made some use of the C-R in attempting to show that gregariousness is not an instinct.(36) Kantor has referred favorably to the C-R in a number of articles. His discussions of reflex action (71) and affective reactions (72) show that it is not inconsistent with the organismic theory. Kuo likewise refers to the C-R in several places. He believes that behavior sets are developed through conditioned responses.(88)

Several psychologists have expressed surprise at the fact that after a C-R is established continued repetition of the conditioned stimulus weakens the connection between it and the conditioned response. This "atrophy through use" contradicts the "law of exercise" which states that practice improves. It has also been observed that in negative adaptation the intensity of the response decreases with continued repetition of the stimulus. The writer has pointed out elsewhere (37) that the data on the C-R principle and on negative adaptation harmonize with each other, and that all of this evidence contradicts the law of exercise. If we consider the stimulus and the response, the law of exercise does not seem to be a correct statement of fact. Another difficulty lies in the concept of backward association: Why do we not observe backward associations in C-R phenomena? We have argued elsewhere (34) that the backward association principle has very little scientific justification. Much confusion will be avoided if we speak of an association between a stimulus and a response, rather than an association between two stimuli. In Pawlow's experiment the bell is not associated with the meat, and the bell stimulus does not produce meat. It is associated with a salivary response.

The Conditioned Response and Abnormal Psychology. The first applications of the C-R principle to abnormal psychology can be traced definitely to Pawlow and Bechtereff.(8) In 1914, while discussing "*Neurograms,*" Prince stated that Pawlow's C-R experiments "show the possibility of linking a physiological process to a psychological process by education, and through the conservation of the association reproducing the physiological process as an act of unconscious memory." (139, p. 139) He says that in these C-R experiments also "is to be found the fundamental principle of what under

other conditions can be recognized as a *psychoneurosis—an abnormal or perverted association and memory.*" In 1916 Wells showed the close connection between von Bechtereff's C-R and affective transference, or *Übertragung.*(163) Wells has also discussed the differences between the two phenomena.(164, pp. 126–134) Kempf makes considerable use of the C-R in his treatment of affective and emotional reactions in connection with autonomic functions (79) and psychopathology.(81) He believes that the C-R mechanism is the cause of much abnormal behavior.(80) Hollingworth advanced a theory of functional neuroses in terms of the mechanism of "redintegration." (54) His objections to the C-R as an explanatory principle are stated in a few words, and an attempt is made to distinguish it from the redintegrative process. The redintegrative mechanism referred to by Hollingworth seems to be closely related to the C-R mechanism. He gives several illustrations of C-R's in support of his general argument. Heilbronner (52) described several examples of hysterical behavior in children acquired mainly by the C-R method. He believes that these habits are very common, and he gives suggestions for the treatment of children so affected.

Humphrey criticized some of the Freudian concepts and explanations from the point of view of the C-R principle. "By simultaneous concurrence," he writes in one article, "there are set up systems of interconnected conditioned reflexes, the reaction to the combined stimuli of which constitutes the Freudian wish." (56) In another article Humphrey attempts to bring the Freudian mechanisms under the C-R rule.(58) A third article is critical of Lay's "*The Child's Unconscious Mind*" from the same angle.(59) Burnham has discussed the relation of the C-R to psychoanalysis and pathology.(25) Allport gives a careful treatment of the relation between Freudian psychology and the C-R on the social side.(1) Lashley makes use of the C-R in his physiological analysis of the libido.(94) Smith and Guthrie have shown that exhibitionism is learned partly by means of the C-R mechanism.(147)

The Physical Basis of the Conditioned Response. Several researches on neurobiotaxis seem to indicate that one of the laws governing the growth of nervous processes is practically the same as the law of contiguity and identical with the C-R principle. Kappers has observed that the selectivity of tract formation depends upon simultaneous or correlative stimulation.(74, 19, 73, 76) In another discussion (75, p. 53) he says that "simultaneous irritations,

which repeatedly penetrate into the nervous system in different places, cause in this nervous system a neurotic association or associative integration between the centers where they arrive. This law is for the material development of the nervous system the same as what we have known for centuries as the law of association in our conscious conceptions (though it was discovered independently of it, without any psychological afterthought)." In 1921 Kappers gave a further discussion of the structural laws of the nervous system and the principles of neurobiotaxis, together with a fairly complete bibliography.(77) Black (16) has followed up some of Kappers' work; and Burnham has pointed out the connection between the C-R and the neurological work of Kappers and Bok.(23) Johnson has discussed the C-R in connection with the physiology of cerebration.(67) The writer attempted a physico-chemical explanation of association and learning as observed in C-R experiments.(33)

After reading the literature on the conditioned response one comes away with a feeling that it is probably *the* method by which habits are formed. But after considering the complexity of mental life and the numerous factors which must contribute to our acquired activities, the conditioned reflex seems to be too simple an explanation to cover the whole field. It is probable that in attempting to clarify the issues involved, several writers have placed too much emphasis on certain concrete phases such as the stimulus and the response. There are many other factors to be considered, and many other problems to be solved. And yet, when an association is formed between salivary secretion in a dog and the sound of a bell, neither the law of exercise, the law of effect, nor "trial and error" is adequate to give a satisfactory explanation. The conditioned reflex principle itself has a definiteness and plausibility which the other theories of learning do not possess.

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HALL, G. STANLEY. *Life and Confessions of a Psychologist.* New York: Appleton, 1923. Pp. ix+623.

Psychologists will find a peculiar interest in this autobiography of one of the pioneers of the science in America. Organizer of the laboratories at Hopkins and Clark Universities, founder of the first psychological periodical in this country, one of the triumvirate which launched the American Psychological Association, the late Stanley Hall has been an outstanding figure among us for more than forty years. Much of his life is a matter of common knowledge, but we are fortunate to have this more complete and intimate record in his own words.

The title of the book is perhaps not exact. It contains very little which could appropriately be called "confessions" in either sense of the word. But it does give an objective account of the author's career and throws light on some of his guiding motives. The history of Clark University, with its many trials and vicissitudes, is told for the first time, we believe, from President Hall's own standpoint. And this account may explain some of the inconsistencies which have been attributed to him in handling the difficult problems with which he was confronted. In fact, the author tells us that his chief motive in undertaking the work was to clear up this episode.

The book opens with a detailed account of Hall's family and ancestry, written in narrative form but containing a fairly critical appraisal which will interest the student of heredity. A long chapter is devoted to the author's childhood and boyhood, followed by a briefer account of his secondary education and college life, and of his student years in Germany. Hall's experiences at Hopkins and Clark complete the historical part of the book. The remaining chapters deal with the author's personal characteristics and with the development of psychology in his time, including an outline of his attitude toward the science.

What we miss in the volume is a critical self-analysis—a study of motives and aspirations, such as one finds in Franklin and Rousseau—not to mention Baskirtseff and other lesser self-explorers. And this raises the question whether any one is really capable of frank self-

revelation to the world at large during his own lifetime. The irresistible tendency to rationalize our own actions is now generally recognized; is there not also a similar tendency to "ethicize" our life history? No American psychologist has championed the psychoanalytic method more zealously than Stanley Hall. Why then did he, a trained introspector, let pass this excellent opportunity to give to the world his inner life history? Undoubtedly, he realized that one's repressions are too strong to tell the truth candidly, and his literary honesty forbade him to "ethicize" the story in the way that earlier confessors have been suspected of doing.

In the last chapter there is an approach to self-revelation. On pages 573–580 Hall discusses several personal traits with unusual frankness, and in many places his religious development is touched upon. In the chapter on Childhood there is a frank discussion of the phenomena of puberty; this, however, is rather a study of his environment than of his own mental growth.

In connection with this book one should read the author's *Recreations of a Psychologist,* some parts of which teem with personality. And we may hope that the lamented author's recent death will release portions of his original manuscripts which proved too intimate for publication during his lifetime.

PRINCETON UNIVERSITY HOWARD C. WARREN

HENNING, HANS. *Psychologische Methoden zur Untersuchung des Geschmachsinns. Abderhalden's Handbuch der biologischen Arbeitsmethoden.* Abt. VI, Teil A, Heft 4. Berlin and Vienna: 1922. Pp. 627–740.

HENNING, HANS. *Der Geruch.* Ein Handbuch für die Gebiete der Psychologie, Physiologie, Botanik, Chemie, Physik, Neurologie, Ethnologie, Sprachwissenschaft, Literatur, Aesthetik und Kulturgeschichte. Leipzig: 1924. Pp. vi+434.

One marvels that, despite the well-known difficulties under which the scientist and his publisher have been forced to labor in modern Germany, works of the kind before us are nevertheless written and printed. The Abderhalden undertaking is one of extravagant proportions into which Henning's monograph finds its place as one of many treatises which, when complete, will embrace the full range of psychological methods, both pure and applied. As for the handbook on Smell, it is, as its subtitle indicates, encyclopaedic in scope. Although appearing nominally as a second and revised edition of a

previous volume bearing the same title (1916), the author informs us that the new book contains scarce a paragraph in common with the old one.

To give a detailed review of these two works would overtax the space at my disposal. I shall therefore confine myself to a somewhat general consideration of Henning's researches and their systematic setting. Regarding the main facts, psychologists are already familiar with Henning's classification of taste with reference to a tetrahedron upon which *sweet, sour, bitter,* and *salt* form the turning points of an otherwise continuous series of qualities; the intermediates, like those of the color-series, being of equal simplicity with the four principal tastes. Thus *alkaline* is a simple taste between *sweet* and *sour,* while the metallic taste, with somewhat less assurance, is placed between *sour, bitter,* and *sweet,* or between two of these and *salty.* As for insipid tastes, these are not tastes at all, but are referred to a tactual impression. Likewise in smell we have the prism with its six turning points of *spicy, flowery, fruity, resinous, putrid,* and *burning* odors.

Experience shows that a mixture of two tastes or two odors is not identical with the simple intermediate which lies between these two. Apparently there are all degrees of intermixture, combination, fusion, and simplicity, upon which only experience can decide. For instance, in taste Henning informs us that the four psychophysically basic processes may operate (1) singly, (2) in groups of a uniform physiological fusion, and (3) in groups that run more or less independently of one another. Thus if but one process is present, such as that of sugar, we experience simple sweetness. If two processes are coupled and physiologically fused as partial processes (such as the salty and bitter processes of chloride of magnesium) we experience a simple transitional taste with several similarities or sensory aspects (bitter-salty). But if two of these processes occur with a certain oppositional independence (cooking salt and cane-sugar mixed), we experience a more or less intimately mixed taste (sweet-salty), the components of which can be analyzed.

Henning's account of all such analyses is bound up with the doctrine of *residua* (G. E. Müller) or *engrammes;* without a central residual process of past experience the observer is unable to apprehend any sensation at all, and is " mentally blind." Henning adheres to the association-psychology " which since Aristotle and Hume has proved a sound basis wherever it has not been senselessly overladen." While this is not the place to discuss this much disputed

doctrine, it is nevertheless important for an understanding of Henning's interpretations to realize that a lack of clear-cut phenomenological descriptions is attributable, perhaps, to his implicit faith in attention as the simple—though itself unexplained—function, whereby the most diverse contents of consciousness can be analyzed.

In the genetic and ethnological portions of the Handbook on Smell, Henning relies upon the "complex-quality" of a "collective apprehension" (Müller) as the key to primitive experience; and in both taste and smell he finds original data largely unspoiled by the analytic and abstractive methods which have raised the "higher" senses to the discriminative level they now enjoy. Thus he opens his account with a statement that "for many sciences, in the beginning was smell." Not only does the complex quality of odor, as well as the nature of its employment by animals, reveal this lower level of apprehension which in primitive man extends to all experiences—so that "outer" and "inner" world constitute for him a single fused unit—but the seat of smell in the olfactory lobes points to its ancient origin as being the first sensory quality to arise with the development of the "new" brain. In addition to being the central organ of smell, these lobes also control sex, procreation, nourishment, and excretion; accordingly, even now, smell possesses its intimate connection with these fundamental processes of life.

A further proof of the primitive character of both taste and smell is found in the imagery of these senses which is always of the "eidetic" type demonstrated by Jaensch and his co-workers as the matrix of all reflective experience. In turn, the eidetic image depends upon an *Urbild* which allows of no distinction whatever between presentation and reflection. Eidetic imagery includes, then, the potential data of after-images, images of memory, and images of imagination. As distinct from any of these later forms of reflection, the eidetic image includes a sense of self, fully projected into its content, and possesses a reality by reason of its close connection with perception. Although not identical with what we call hallucination, the eidetic image indicates a transition between it and perception.

Between the ages of four and twelve the experience of a child undergoes a transformation in which the eidetic imagery splits up into after-images and ideas, over against which the self is made to stand as observer. This transformation is chiefly effected by modes of apprehension; in general, interesting objects retain their eidetic character longer than do uninteresting objects. A red object

may be experimentally repeated in a child's experience until, through weariness, he suddenly, and for the first time, experiences to his vast astonishment a green after-image.

According to Henning, images of taste and smell always remain eidetic; thus lacking the differential remoteness of signs and symbols which derive from the higher sense.

The stimuli of taste are particles dissolved in a liquid solution, while those of smell are vaporizing particles dissolved in air. Liquids have no odor, and the fact that water-animals smell is attributable to a difference in the constitution of their sense-organs. Henning can find no adequate grounds for the assumption of an original "chemical sense" such as has been proposed by G. H. Parker.

While the exact chemistry of neither taste nor smell stimuli is as yet certain, it appears that atomic grouping and the constitutional character of a chemical are essential features, rather than the atomic or ionic ingredients, as such. In taste, we are told that the different series, salty to bitter, salty to sweet, sweet to bitter, etc., always repeat certain inorganic chemical constellations, either in the sense of the periodic law, or of certain groupings of ions. In smell, olfactory elements are found in the fourth, fifth, sixth, and seventh groups of the periodic system, though not all members of these groups give odor, nor do all combinations containing these elements. Consequently, the elements themselves can only be regarded as "radicals" to which a certain atomic grouping or a chemical constitution must be added.

For the most part, the elements themselves are odorless; the exceptions being fluorine, chlorine, bromine, and iodine. Since the same odor is often obtained from different chemical classes which have a like combination of osmophoric groups, it is apparent that the form of constitution is more significant than the elemental ingredients.

As regards mode of stimulation, taste seems to go with ionization, while smell is referred to a colloid-chemical process of adsorption. The intensity of smell varies directly with the nature of the solution of vaporized air particles, and increases in proportions which accord with the Weber-Fechner law. In addition to experienced intensity, smell also possesses an objective force determined by physico-chemical conditions. The stimulus of smell is not the sum of the odoriferous particles, but the number of these vaporizing in the nose and available to the sense organs.

Phenomenologically, a complex which is a uniform whole possesses properties and effects which cannot be derived from the properties and effects of its separate constituents. Primitive complexes contain the ego as an active participant within the complex itself; consequently all flows together, as instanced in magical and eidetic phenomena. Although the adult mind distinguishes a *given* or "subjective" odor from an *object-odor,* the former is an artificial result of analysis, whereas the latter is an original mode of total experience characteristic of the primitive mind, involving as it does both the participation of the ego and many other senses beside smell. Thus object-odors associate readily and without effort with other modes of experience, and one finds no generative competition or inhibition in their recall. *Given* or "subjective" odors, on the other hand, associate less readily with one another and with other modes of experience. The experience of youth is peculiarly rich in object-odors which are readily recalled, when not too persistently searched for, and which lend color and reality to the recollections of youth. The eidetic character of these images explains the futility of special effort in their reproduction, and likewise throws light upon the nature of the psychoanalytic method of revival. Parenthetically, it may also be remarked that Henning regards the eidetic image as the associational vehicle whereby the conditioned reflex operates.

The sense of smell depends so largely upon the active participation of other senses, especially vision, that a characteristic odor may fade and vanish in the dark, and experienced wine tasters are unable to distinguish red wine from white when blindfolded.

The complex quality is not merely formal and affective, but is often diversely sensory. Thus, analogies so readily drawn from sense to sense—dull odors, dull tones, dull colors; stinging odors, sharp tones, blinding colors; the universal characterizations of hard and soft, warm and cold, clear and unclear, simple and compound, rich and empty, etc., etc.—can often be referred to identical sensory constituents of the complex other than those that give it its name. This fact, however, does not preclude the possibility that residual effects and affective conditions may also be involved.

Another difficulty attaching to the analysis of taste and smell is the complete fusion of these percepts with eidetic imagery, which may modify the complex profoundly without the possibility of recourse to the abstract methods of analysis available in sight and hearing. Precise analysis, however, is aided in both senses by the distinctions that

can be drawn: in taste, between *monoglottic* fusion, when but a single region of the tongue is involved; *dichoglottic* combination, when two separate zones each furnishes a different taste; and *diglottic* mixture, when two separate zones each responds with the same taste; likewise, in smell, where we have *monorhinal, dichorhinal,* and *dirhinal* odors.

An important factor in the fusion of taste and smell is *nasal smell,* which constitutes a twelfth sense provided for by a distinct sense organ in the nose. The peculiarity of this sense is that it reacts to gases, whereas the tongue reacts only to liquids. Accordingly, substances bitter to the tongue may be sweet or sour to the nose; for instance, the natural oils of blossoms and fruit peel. A salty smell is less frequent and less intensive than the other three qualities of taste. The fusion of smell with nasal taste is not only different, but is much more intimate than the fusion of smell with taste in the mouth.

The fatigue of smell is shown to be a complicated affair, involving attention, mental fatigue, peripheral nerve fatigue, end-organ fatigue, and nasal taste. Complete compensation is denied to both taste and smell; weak impressions, however, may become subliminal through the influence of central factors.

The elementary simplicity of a smell is determinable only by experience; whenever different parts can be discerned we have multiplicity. A chemical combination like that of cologne-water may arouse either a simple or a multiple odor, whereas a chemical simple can arouse only an elementary experience. Whenever an objective mixture appears simple we are inclined to speak of fusion; but whether this is to be understood as a resultant of two psychophysical stimulations, or as a phenomenal fusion of two odors into one, is an open question. All object-odors fuse; but with "given" odors those of a similar quality fuse most readily.

This review is but a fragmentary sampling of Henning's two works and leaves out of account many interesting discussions of folklore, the esthetics of odors, the botany of smell, the evidence brought for "mixed feelings" and the reproduction of affects, the behavior of animals to smell, etc.; but perhaps enough has been recorded to whet the appetite of the reader to go directly to the Handbook for its rich store of psychological materials.

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OGDEN, R. M. *Hearing.* New York: Harcourt, Brace, 1924. Pp. ix+351.

Of making many textbooks of psychology there is no end; but of writing treatises which deal competently and critically with special fields of general psychology there is all too little. It is therefore gratifying to find a psychologist like Ogden devoting his energies and talents to bringing order out of the mass of literature in a field where he is a recognized authority. It is also gratifying to find a psychologist who is willing "to select those facts which appeared the more significant and trustworthy, and then allow them to fall into their own system of organization." One has the comfortable feeling that the author is not distributing his emphasis by way of inclusion and exclusion in order that he may make the facts fit some particular theory or point of view. The conclusions follow not from premises of the author's own choosing but from a critical sifting and weighing of evidence furnished for the most part by experimental data; and they are put forward not after the manner too often common to the art of the dialectician, but rather with the attitude of the true scientist who is ever ready to amend conclusions as soon as new research warrants.

Ogden does not address his book to psychologists alone. There is nothing on the title page, in fact, which would indicate that the subject is handled primarily from a psychological point of view. Although "unable to avoid the terminology and the attitude which a student of psychology is apt to adopt," the author would be gratified "if the teacher, the musician, the linguist, and the medical practitioner—especially if he be an otologist—could each find something to help him in the solution of his special problems." He might have added that the psychological terminology and attitude adopted derive to some extent from *Gestaltpsychologie* with such modifications as are required by adherence to the conviction that some sort of introspective analysis into simple attributes should be made of phenomenological configurations.

The factual material which forms the basis of the present volume is gathered chiefly from experimental and theoretical investigations of the psychology of hearing, a subject which the author has followed closely during the last two decades. The author has not been content, however, to confine himself to the more immediate implications of these studies, but has pursued their ramifications into the more complicated domains of music and pedagogy. The clarity and good

logic with which he has confronted these latter intricate problems constitute a big step in advance along that path which Helmholtz started upon but which he himself, as he tells us in the closing paragraph of his monumental work on the same subject, preferred not to follow.

The first two chapters deal with the physical properties of sound, the physiology of hearing, and typical theories which have been advanced in explanation of the facts of auditory sensation. Chapters III to VII, inclusive, are of especial interest and importance to students of general and experimental psychology. There is a detailed and admirable treatment of the elementary aspects of auditory experience. Ogden approaches this topic by dividing auditory perception into three parts: tonal, vocal, and noisy. This division is made on the basis of the degree to which the simple attributes enter into each type of percept. The percepts are all describable in terms of five attributes: pitch, brightness, intensity, duration, and volume. *Brightness* is that quality of tone by which we note that high tones are intrinsically sharp or piercing and low tones dull or blunt. Abraham's work with the siren has demonstrated that a modification of wavelength without a corresponding modification in frequency is a condition under which brightness varies independently of pitch. Rich's experiments on *volume* furnish ample evidence of the independent variability of that aspect of auditory experience which is referred to when we speak of the massiveness or extensity of a tone. Ogden rejects tonality and vocality as elementary aspects of auditory perception inasmuch as they involve either relations between tones or integrations of other attributes over indefinite pitch-regions. With the aid of these five simple attributes, then, especially pitch, brightness, and volume, Ogden is able to differentiate and characterize the three percepts: tone, vocable, and noise. A thorough examination is made of the numerous studies of vocables, and fourteen pages of valuable and most welcome material are devoted to that topic which is passed over so quietly and summarily in textbooks and classrooms, viz., noise. "The clear emergence of a pitch-salient, commanding and subordinating all other salients that may be present in the sound-mass, is the characteristic of tone. Lack of such a predominance, in a complex sound, through lack of order and a regular subordination of the salients of pitch, together with a rough dullness or a sharp brightness occasioned by an asymmetry of the sound-wave, is the characteristic of noise. The vocalic formants seem to occupy a mid-

dle ground, for while a certain regularity is indicated among the several components of a vocable, the formants lack saliency of pitch, although they appear to possess the smoothness of a tone rather than the roughness of noise."

After pointing out the weaknesses, as well as the strong points, in various theories of auditory fusion (Helmholtz, Krüger, Lipps, Stumpf, Watt) Ogden develops his own conception of an harmonic theory of fusion according to which certain unique integrations of tones, notably the octave, fifth, fourth, and to lesser extent the sixths and thirds, are accounted for biologically by reference to ingrained dispositional tendencies, both innate and acquired. It so happens that these unique integrations or fusing intervals are the very ones that are most conspicuous among the partials of a clang. Frequent exposure to these intervals in the "harmonic chord of nature" has resulted in a selective adaptation of the auditory mechanism so that the experiences are brought to consciousness as compulsory unities which must be accepted as such. Fusions, tones, noises, and vocables are all more or less compulsory percepts. It is only by a process of refined observational abstraction that we arrive at a knowledge of the integrating attributes which condition the different characters of these percepts.

Among the principles of tonality Ogden lays particular stress on the law of equal intervals as furnishing the clue to the formation of musical scales (Chapters VII and VIII). Certain intervals are "given" naturally in the phenomena of fusion; other intervals, especially those which operate in sequences of tones, derive from a unique ability to apprehend readily equal proportions of volumic differences. A study of scales reveals the fact that the sequences of tones which go to make up the scales are limited at the extremes by harmonic or fused intervals, but that in many scales there occur between the limits bounded by the harmonic interval intermediate interval-divisions which do not comply with the conditions of an harmonic series. To account for these nonharmonic divisions Ogden makes use of the above principle of equal intervals at the basis of which lies the capacity for estimating volumic proportions. Since this principle plays such an important part in the author's treatment of tonality and music it would have been well, so it seems to the reviewer at any rate, had he given a more detailed and explicit account of the grounds on which he bases his conclusion that volume rather than pitch is the determining factor in the estimation of interval-differences.

Chapter IX takes up the problem of language and indicates the manner in which the simple attributes enter into the formations of the sounds of speech, and the program which future research should follow in this field. Chapter X introduces the reader to the methods by which the elements of the art of music may be subjected to scientific analysis. The principles of music derive largely from the laws of auditory sense perception discussed in earlier chapters, and the laws of the tonic, cadence, falling inflection, return, and equal intervals, which govern the phenomena of tonality. In the melodic structures of the music of the East the principle of equal intervals seems paramount, whereas in the musical structures of the West the principle of harmony assumes greater importance on account of the practice of building up chords, even in counterpoint, which are concordant in effect. The author shows how concordance varies with the attitude of the listener, and devotes an interesting section to a discussion of the reasonableness of certain of the attempts of ultra-modernists to free music from some of its fetters. Music is more flexible and more capable of fine gradations of expression than the other arts because its reference is not primarily to the objects and common sense meanings of the world about us but rather to the unique beauties which characterize the infinite variety of patterns and formations into which its own contents may be shaped.

In the chapter on the localization of sound (XI) Ogden cites the experimental evidence by which we are enabled to say that the perception of the direction of sound is conditioned by differences in phase, time, and intensity, but insists that a psychological theory of localization cannot be expressed in terms of the bare facts of uniform correlation between physical conditions and judgment. There must be some phenomenological criterion for localization registered in the sound as heard. Ogden is inclined to infer that this criterion is brightness, or perhaps volume, or a combination of both.

The principal defects of hearing are reviewed in Chapter XII. The last chapter is an excellent presentation of the relation which the science of hearing bears to the problems involved in linguistic and musical education. It cannot be too highly recommended to those interested in these matters. In it are discussed the benefits which would accrue to the teaching of language and music if those responsible for such instruction would only direct the attention of pupils to the fascinations and beauties of sounds themselves instead of

always to the practical use to which sounds are put in language and to the formal technicalities and rules of music.

Ogden's work will undobtedly find readers who approach the subject of sound from various angles and interests. But since the book will probably appeal most strongly to psychologists, one wonders whether the author could not have added to the interest and clarity of exposition of the text, as far as psychologists are concerned, by stating his own general point of view regarding mental phenomena. This could have been done without necessarily prejudging the interpretation of the data dealt with, and would have made more obvious in places (*e.g.*, pp. 268ff.) the reasons for some of the author's conclusions. The book is provided with a good index and a valuable list of 150 references to literature on audition.

HARVARD UNIVERSITY CARROLL C. PRATT

PEAR, T. H. *Remembering and Forgetting.* New York: Dutton, 1922. Pp. xii+242.

The somewhat agglomerate nature of this book is accounted for, in part at least, by its development from a course of lectures to army medical officers on the subject of remembering and forgetting, and the addition to this of various related material. "The interest of the general reader has been kept in mind" (rather darkly at times), but the student of psychology will find many suggestions and much profit here. The author, who is professor of psychology in the University of Manchester, had for his object a guidebook rather than a textbook, and the result is very human and readable.

The subject of imagery is discussed in several chapters, and its selective nature is emphasized. Dr. Mabel R. Fernald's "The Diagnosis of Mental Imagery" (*Psychol. Rev. Monog. Sup.*, No. 58) is deservedly commended. Professor Pear does not believe that pure types (visual, auditory, motor, etc.) exist practically, but he does not approve of the dismissal of important differences as merely "mixed." "It is usual for an individual to possess one sense-sphere the imagery of which is predominant over that from the others" (p. 23). The author stresses the common inability of one type to appreciate another and, although a visualizer himself, pays particular attention to kinesthesis. After presenting the opposing views of Washburn and Titchener on kinesthetic imagery (the former holds that such images are in reality sensations based on slight muscular movements), he leaves open the question of its existence; but he adds a very inter-

esting chapter in the appendix on "The Intellectual Respectability of Muscular Skill," which contains a plea and suggestions for the development of a kinesthetic language.

A chapter is devoted to "The Percept and the Image," and then follows "The Functions of the Image." "The chief function of imagery seems to be the conveyance of a meaning" (p. 44), and the author agrees with Dr. Schiller that the latter is "essentially progressive" and personal. "The image plus its meaning is nowadays generally known as the idea" (p. 48). Professor Pear cautiously subscribes to the belief that imageless awareness may occur, particularly in the case of abstract thinkers, and this leads him again to discuss the psychological nature of meaning, which he regards as "the consciousness which occurs in connection with adapted behavior, overt or incipient, explicit or implicit" (p. 62). Professor Margaret F. Washburn's theory of the relation between meaning and felt movement is referred to with approval. In considering the relative independence of image and meaning, the author, although not at all averse to introspection, sees in the dream structure the clearest support. Certain of his examples, however, are none too obvious (pp. 51, 52).

The consideration of dreams occupies more than one-third of the book proper. "Usually—perhaps always—the dream is composed of recalled experience. It can therefore be included among the phenomena of memory. While all memory is selective, the dream usually exhibits the results of this picking and choosing in a pronounced form" (p. 107). Here Professor Pear pursues further his study of the relation between image and meaning, and the allied problem of mental control. The views of Freud and of Rivers are presented and discussed, and the author includes an analysis of one of his own dreams.

In the long and interesting chapter, "How We Forget," Freud and Rivers are again given major attention, and the theories of the latter on suppression and repression are described. Professor Pear presents (p. 166) the following provisional classification of forgotten experiences:

1. Embodied
   - (a) Apparently insignificant.
   - (b) Significant, but completely congruous with the personality.
2. Exiled.
3. Superseded.

The term "embodied" is preferred to the "fused" of Rivers, and "exiled" comprises repressed experiences, while "superseded" is used in a sense similar to "retired," our "dead selves." The author realizes the possibility that repression may account for these "superseded" memories, but he thinks of them as "seldom invited to enter" consciousness rather than as expelled therefrom.

The book concludes with an appendix in which, besides the chapter on kinesthesis previously referred to, there are chapters on "Synaesthesia," "Number-Forms," and a brief account of the neurological work of Head and Rivers and its relation to imagery.

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Werner, Heinz. *Die Ursprünge des Lyrik.* Münich: Reinhardt, 1924.

In the treatment of the problem of the esthetic the fact of our loss of a clear orientation comes home to us.

The present study in esthetic origins shows the point of view and the method of Wundt's *Vergleichende Psychologie,* which endeavored to reconstitute the "psychical life" of animals, of children, and of primitive and extinct peoples and cultures. This objective, thus stated, has receded, for us, into the background and new objectives have not yet clearly emerged. The service of the present work—which, the author tells us, has lain practically complete since the close of the late war—may then lie in the fact that it leads us to a scrutiny of the objective and of the method.

To define the objective of an *Entwickelungspsychologie der Künste* is a big order if one desires clearness of conception, requiring, as it does, besides definition of the mooted psychical, also that of evolution and of the esthetic. The conception of evolution is under criticism on other grounds than those put forth by reactionary theological fundamentalists; and an unambiguous definition of the nature of the esthetic has never been aggressively promulgated.

Werner takes the products of one field of esthetic activity, viz., poetry, and seeks its origins in preësthetic, "esthetoid," activities, somewhat after the manner in which the biologist seeks the descent of *homo sapiens* from "anthropoid" forms. This type of objective is familiar enough, though it may be that the zest for it has become somewhat dulled in these *post-bellum* days.

As to Werner's method, we said that that showed the traces of the Wundtian influence. The origin of the lyrical, *i.e.,* of poetry, in

the "primitive" psyche is to be discovered by the application of the comparative formula, that is, primitive behavior and its products are to be "psychologized."

This psychologizing reveals the fundamental motives that give rise to the "esthetoid" and eventually, in a modified form, to the esthetic activities. The "esthetoid" activities, Werner thinks, fall into two groups: (1) the "meaningless" activities that have their rise in reflex motor discharge of pleasantly toned states, and may take the form of nonsense rhymes in the field of poetry or of jazz in the realms of music and the dance; (2) the "meaningful" activities that have their source in "balked" desire—always unpleasant—as in hunger and love, in grief over the departed dead, and in the anger arising when one's wishes have been crossed. It is these activities of the preësthetic stage that furnish the *content* upon which the esthetic activity operates.

The hypothesis that emerges is familiar enough. The "original" activities having been held up, their part-contents, whether stimulus-object, reaction-tendency, or emotional processes, may become the subject of attention in the specifically differentiated esthetic attitude or *einstellung*. In so far forth the "original" purpose has been modified. The esthetic envisagement is the final term of an evolutionary process in which the natural objectives are voided. One is reminded of Santayana's application of this sort of hypothesis to the religious life. It there similarly voids the objectives of that life by negating them intellectually and then gives to the erstwhile faithful a substitute: "Your religious beliefs must not seek rational justification; it is their function to give esthetic satisfaction."

Two criticisms suggest themselves. One is a question of fact. The "meaningful" activities that may furnish occasion also for the operation of the esthetic attitude are not necessarily of the unpleasant variety. The songs of the chase, of love and war, and of death, tell of achievement as well as of failure; they bespeak hope as well as despair. The other criticism can be merely indicated. Werner operates with the conception of "evolution" after a manner not more loose than that of many others who bring it before the public in these latter days as something to be "accepted" as a matter of course. But the lack of clear-cut definition of the concept and its implications, whenever that lack occurs, tends, in the opinion of the reviewer, to give us a pseudo-science that in its dogmatism may be stultifying.

UNIVERSITY OF ILLINOIS CARL RAHN

SPEARMAN, C. S. *The Nature of "Intelligence" and the Principles of Cognition.* London and N. Y.: Macmillan, 1923. Pp. vii+358.

The instructed psychologist, if pressed for time, may obtain the essentials of the author's program by beginning with Spearman's own excellent Summary, following this with Part II. But he will thus miss one of the best critical surveys of the state of modern psychology with which the reviewer is familiar (Part I) and the best evidence for the fruitfulness of Spearman's proposed principles (Part III).

Despite all the efforts of mental testers, the meaning of "intelligence" eludes us for the simple reason that the term does not at present possess a definite meaning. Nor can we give it a settled meaning which will be satisfactory until we have placed it in respect to other aspects of cognition. But when we turn to cognition, we find the same deplorable lack of ultimate laws of which James complained three decades ago. We have, to be sure, in the works of leading psychologists, "many deep thoughts and much felicitous language." But psychology has never succeeded, as more progressive sciences have, in rendering the best of the older men obsolete. Even the triumphs of experimental psychology "attain to the dimensions of splendid raids rather than to those of consolidated conquest." Generalizations we have but no pregnant system of principles like those with which Newton invested physics. Spearman does not shy off from the implied comparison; with proper modesty, he would do for psychology, or at least for cognition, what Newton did for mechanics.

Knowing is an act which may or may not supervene upon that "lived" or enjoyed experience which forms its basis or provides its material or content. But since knowing (as well as conative) acts are themselves experiences, we have two kinds of experience: the one kind consists of mental states or affections, that is to say, sensations and feelings; the other of cognitive and conative acts. Since any experience may be cognized, it is clear that we may know our own knowing—the obvious basis of introspection in the cognitive field. But the primary kind of experience is, of course, sentience.

There are three "qualitative" laws which prescribe the nature of cognition. Supplementing, almost, we may say, limiting, these are five "quantitative" laws which determine the relative "intensity" of the cognition prescribed by the three qualitative laws. Correspond-

ing to the qualitative laws, there are three kinds of acts giving rise to knowledge. The basic one is *apprehension*. "Any lived experience," runs the first cognitive principle, "tends to evoke immediately a knowing of its direct attributes and its experiencer."

But knowledge is not limited to apprehension. For between two characters of experience (or between two experiences) we may know *relations*. These are drawn out or *educed* from the nature of the characters as presented. For the eduction of relations, the characters must be cognized; merely lived experience will not suffice though the relation may be much more clearly cognized than its "fundaments." The second principle of cognition reads thus: "The presenting of any two or more characters tends to evoke immediately a knowing of relation between them."

The third cognitive process has frequently been confused with the second. It runs: "The presentation of any character together with a relation tends to evoke immediately a knowing of the correlative character." It is clear that there is some justification for the prevalent identification of this process with the evocation of relations. The final cognitive result is the same: two apprehended characters standing in a cognized relation, one to the other. But in one case we begin with the two characters and educe the relation; in the other we begin with one character and a determinate relation and educe the character which stands in that relation with the first.

The three qualitative principles Spearman calls "noegenetic." They possess both noetic and generative virtue. "By noetic is meant any cognitive transition that is valid self-evidently. By generative is meant any bringing of an item into awareness by a process which does not postulate its having been there before. These two virtues, noetic and generative, would appear to be inseparable."

To a fuller consideration of the five "quantitative principles," Spearman proposes to give much space in a forthcoming book on mental tests; they are accordingly dealt with more briefly than the noegenetic principles, which are in any case regarded as more definitively established. The five "quantitative" principles are those of mental energy, retentivity (inertia, facilitation, association), fatigue, conative control, primordial potency.

The total mental energy tends to remain constant, at least as regards the cognitive output. We have here, obviously, Spearman's well known general factor, *g*, the underlying basis in all mental tests. But this principle is also intended to cover many of the phenomena of the range of consciousness and attention.

Retentivity is considered as a principle that extends to mental processes of all sorts and even governs an immense number of purely physical events. The range for psychology extends from the lag of sensation, through perseveration, to facilitation by repetition and association.

Fatigue is recognized as a principle working in opposition to the last one. Spearman does no more than indicate the direction of a number of problems which occur in this connection.

"The intensity of cognition may be controlled by conation." Here again we have a principle which covers some of the manifestations of what has been called attention, more particularly voluntary attention. Spearman, though his own study is devoted to cognition, regards conation as the more fundamental aspect of mental life. This fourth cognitive principle is the nexus by which conation is brought into its relation with cognition. "This principle brings to simple scientific expression, and therefore prepares for exact scientific investigation, the main facts furnishing the bases of the theories of Freud and Jung." It is in this connection, we may add, that the doctrine of the sentiments as worked out by Shand and McDougall would have to be considered.

Finally, the degree of any particular cognitive process is determined by certain primordial potencies; these vary from individual to individual, and in each individual they are of unequal strength *inter se*. These primordial potencies will be recognized as the special factors, *s*, which combine with the general factor, *g*, in determining the mental test score. (The relation of the three intervening quantitative principles to the test score will be worked out in greater detail in the forthcoming book; although they are general factors, only occasionally do they materially affect the test score as do *g* and *s*.)

These five quantitative principles do not correspond to cognitive processes but they bring about three processes by joint action. These three processes are *reproduction*, *disparition*, and *clearness-variation*. These three "anoegenetic" processes, together with the three noegenetic processes which correspond to the first three qualitative principles, exhaust the whole domain of cognitive activity.

We have spoken as if degree of cognition were a term of self-evident meaning. Such is not, of course, the case. In an interesting chapter (Chapter XI) Spearman considers in what the growth of cognition consists. On experimental grounds, he breaks up clearness into two processes of intensification and determination, the latter

giving rise to or rather affording scope for differentiation. The apprehension of experience (the primary cognitive process) is not greatly impeded by indeterminateness; "one may be quite sharply aware of thinking unsharply." But eduction, whether of relations or of correlates, is hindered greatly by the indeterminateness of their fundaments, that is, by the indeterminateness with which the characters involved are cognized.

With regard to the other constituent of clearness, the situation is curiously inverted: when the intensity becomes very low, the power of experiential apprehension or introspection rapidly declines, while the power of eduction remains little affected. "In this way it comes about that a cognitive item of low intensity [it must be remembered that Spearman does not mean sensory intensity but something like the *Bewusstseinsgrad*] can be very 'clear' in the sense of intrinsically determinate and eductively effective, and nevertheless at the same time very 'unclear' in the sense of unamenable to introspective apprehension." Experience which is thus unamenable to apprehension is "subconscious." Where the subconscious experience is of the sentient order, we have anoetic sentience. Something which closely approaches this as a limit, Spearman thinks may be experimentally induced. But we may have subconscious experience which is noetic and even "noegenetic" since it may give rise to the second and third cognitive processes. The determining tendencies and sets, not to mention the complexes of the psychoanalyst, are subconscious experiences of this sort.

Criticism may be begun at this point and concerns itself first with the matter of terminology which Spearman himself insists is vitally important. This use of the term subconscious seems to the reviewer inconsistent and unfortunate. Doubtless it concurs with a large body of current usage, but current usage is here in a hopeless mess. Of the two main significations which the word consciousness has had—the awareness of experience or the experience itself—Spearman adopts the latter as now ineradicable in our modern vocabulary. Yet confusion constantly arises because of a certain persistence of the older meaning. Now Spearman proposes to use subconsciousness to suggest this older meaning of consciousness and thus to perpetuate the confusion in the meaning of the parent word. And for him this is unnecessary. As he uses the terms, the subconscious and the unintrospected or the unintrospectible are identical. A great deal of nonsense would be avoided if persons who mean merely the unintro-

spected would use that term instead of a pseudo-mystic concept like the subconscious; and those who might be trusted, like Spearman, to use the latter term scientifically should none the less renounce it for the sake of these others.

The limitations of space prevent any attempt to summarize or criticize Spearman's analysis of the different kinds of eduction of relations and correlates. We must similarly pass over his criticism of the sensationalist doctrine of thought and his explanation of its origin. Both are matters of detail, though of important detail. Nor may we comment upon the interesting way in which Spearman has analyzed the traditional rubrics of cognition—Perception and Movement, Intellect, Memory, and Imagination—into his six cognitive processes of experiential apprehension, eduction of relations, eduction of correlates, reproduction, disparition, and clearness-variation. The extent of cross-classification makes it doubtful whether both divisions can survive. The advantages of Spearman's treatment cannot be adequately summarized. It will not be denied that his analysis is very neat.

Indeed, the criticism has been ventured that it is too neat, that we have a system of logic, not a system of psychology. The reviewer confesses his inability to understand this much used criticism. At any rate, Spearman's answer is plain: all the processes are alleged to be introspectively discovered under the conditions of experimental control. There is logic in their formulation—there must be—but not in their substance.

Detailed criticism of the five quantitative principles would be premature since the author reserves them for fuller treatment later. The book before us is essentially an exposition of the three noegenetic processes. The treatment of relations is vigorous and their classification has much merit. But it is difficult to see that in principle we have anything novel here. On the other hand, all psychologists who do not rule relations out of their science incontinently must recognize in the eduction of correlates a parallel which is significant. It is a matter urgently demanding investigation whether the differences between "mechanical" and "meaningful" memory—the matter is variously phrased by different discoverers—which crop out every now and then in experimental investigations may not be due to the influences of reproduction and correlate-eduction, respectively. For Spearman shows that the latter *looks* in many cases very much like memorial reproduction and is definitely different. Even those psy-

chologists who give a sensationalistic explanation to the awareness of relations must come to terms with the process of correlate-eduction, though in schema the reduction of this process, deemed by Spearman an ultimate one, will be clear to any sensationalist.

From a systematic viewpoint, however (and avowedly this is the important one), the first cognitive principle is the most significant. It seems innocuous at first but it embodies a complete systematic position. In effect, Spearman is joining Külpe in his return to the Scholastic (and Platonic) position of an "outer and inner sense." Intervening between reality and knowledge we have experience, a mental *state* which we live, enjoy, undergo. This it is which by "inner sense" or *con*sciousness (in the etymological sense) we know or apprehend. "An ordinary percept," to be sure, "especially if visual, will be regarded as including far more than any mere mental state. Instead of furnishing a starting point from which to explain the laws of cognition, it is something very complex, which needs such laws for its own explanation."

The chief support for "this precious distinction" between the knowing of experience and that experience itself is found in experiments described in Chapters XI and XIV. In addition, Spearman cites a veritable cloud of witnesses from Democritus and Plato down to the latest advocate of the Unconscious in whose writing is implicit or explicit this doctrine. The reviewer, though he believes that there is more in cognition than sensation and the mechanics of association, cannot feel that Spearman has made good this point which he obviously regards as central. The experiments cited certainly need confirmation and supplementation. An English critic tells us that he rose from his reading of the book with the feeling that he must review once more the classical authorities and look well to his whole systematic position. The present reviewer is impelled far more to repeat and elaborate Spearman's experiments on clearness.

Nor is it altogether certain, even should the facts prove to be just as Spearman has found them, that they must be interpreted in his way. No doubt since Berkeley it is impossible to conceive of percepts as images of a substantially real world. But in psychology we have to deal with certain objects, forgetful so far as may be of their metaphysical nature. The objects of everyday intercourse have, as known, certain characters. That we first sense these characters (in any psychological and not merely physiological meaning), and then in addition apprehend them, seems an unnecessary and uncalled

for complication. Doubtless there are modes or degrees of apprehension and these we shall have to distinguish; these varieties of apprehension are one of the grounds for positing both sentience and apprehension, the other being the purely philosophical bias that the characters must be somehow mental as such and in their own right.

But it seems much simpler to abandon sentience—and indeed experience as Spearman uses the term—altogether. We should then find ourselves with certain objects—of many sorts—having characters which can be ascertained and listed, and we should have several kinds and degrees of apprehension of those characters. Psychology, while much concerned as to what these characters are which can be apprehended, cares not a straw about their inmost nature. Let them be mental, material, neutral, or mixed. This suggestion seems to the reviewer the most hopeful way of ridding psychology of epistemological difficulties. Apprehension appears to be a more complex process than in Spearman's system, but the complexities arise from the psychological data. And by an ironical twist it looks as if Spearman had provided the upholders of this viewpoint, which may be dubbed psychological realism, with suggestions for the solution of some of their outstanding difficulties.

The style of the book is vigorous and even epigrammatic, overlaid upon a truly scholastic effort at clearness and consistency in the definition and use of terms. The citation of experimental evidence save that from his own laboratory is frequent but generally lacking in detail. Nearly all the data derive from those in the line of the Würzburg school. Mental tests are used more in illustration than in proof, though the author shows how important may be the bearing of these tests upon general psychological theory. (We may confidently expect much more in this direction in the forthcoming book which will discuss the "quantitative" principles of cognition.) But the reader can scarcely avoid the feeling that the important framework of this book is deductive, though it is supported by empirical evidence. But that is clearly the case also with the traditional account, which this book so sharply challenges. We overlook the enormous amount of *a priori* theorizing in our own psychology because we are used to it. Present day psychology cannot ignore this book. Either Spearman is almost entirely wrong or this is one of the most important books in recent years.

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PORTEUS, S. D. *Studies in Mental Deviations.* Vineland, N. J.: 1922. Pp. xi+276.

There are collected in this volume a number of studies, diverse in content, representing, according to the author, necessary angles of approach to a well-grounded study of mental deviations. The choice of the lines of investigation pursued for these studies has been determined by the fact that the physical, mental, industrial, educational, and social characteristics of the defective have each an important bearing on his social adaptability. Some of the matter published in this book has already appeared in the form of research bulletins dealing with single studies, but is again included in this book so that the various parts of the author's method should not be considered in isolation, but in relation to the general plan followed by him in the study of mental deviations.

For the purpose of some of these studies, without pretending in any way that this constitutes a mental diagnosis, the cases have been divided in two groups—those *below* and those *above* 75 I.Q. (average Binet-Porteus mental ages). Each of these two groups is further subdivided into *well-adjusted* and *mal-adjusted;* and the latter into those showing psychopathic tendencies and those with delinquent tendencies. An interesting conclusion from the analysis which accompanies this classification is that delinquency tends to be associated with the higher grades of defective mentality, and that the really great menaces to society are the dull normal delinquent and psychopathic groups.

In a section devoted to Anthropometric Studies are presented the results of a number of studies of brain capacity as determined by length, breadth, and height of head. In summing up the results, the conclusion is drawn that for the *well-adjusted* groups there is a decided relation between the size of the head and intelligence; the lower the mentality, the lower the average capacity and the greater the percentage of extreme deviation either in capacity or single measurement. The *delinquent* groups do not show the same relation between brain capacity and mental level, their average capacities and distribution of percentiles approaching much nearer to the normal. On the other hand, as regards the form of the head as expressed by cranial indices, the *psychopathic* show a greater percentage of marked deviations from the normal averages. With reference to these and other results the author observes that the comparison of averages, unless based on a large number of cases, may be misleading. He fails

to emphasize, however, the inadequacy of the average as a criterion for individual diagnosis.

A chapter is devoted to the discussion of the history of the Porteus Maze Test and to a report of recent investigations with this test. These investigations lead to the conclusion that "as regards the prognosis of educational progress the Binet test has considerably better reliability than the Porteus, but that as regards social and industrial adaptability the advantage is with the Porteus test, particularly in the case of girls." As a diagnostic symptom it is said that a distinctly lower Porteus than Binet age may be considered indicative of social and industrial inadaptability, maladjustment being very frequently due to psychopathic tendencies. The advantage of combining the two tests into a battery and the greater reliability of the combined results in prognosing social and industrial adaptability is discussed.

A lengthy chapter is devoted to discussions of a social rating scale devised by Porteus and to a discussion of experimental investigations of its usefulness. The social rating scale under discussion is one limited to the subsocial, that is, one for rating social inefficiency rather than the degrees of social efficiency. The traits to be judged are confined to defects and the number to be rated are those which are most characteristic of defectives. There are many sound conclusions about social rating scales in general, but the reviewer questions the validity of the procedure of comparing ratings on the scale with social estimates by the same observers as a method of checking the reliability of the Porteus scale. The r .94 which such a procedure gives in one case may very well be more an indication of the agreement of the individual observer with himself than a sign of the usefulness of the scale under discussion. A few pages are devoted to a discussion of the correlation of mental tests with social ratings.

In a chapter on Analysis of Binet Results is presented a battery of eight tests selected from the Binet series to be used in obtaining a Binet diagnostic score, which has a positive value in that it is very improbable that a child making that score will be feebleminded. It is also pointed out that results obtained by the author cannot confirm the view that "scattering" on the Binet is a very reliable indication of psychopathy.

A very interesting chapter in the book describes an industrial rating scale devised by the author. A job analysis was made of every occupation in the Vineland institution and a scale constructed

which makes possible a comparison of the industrial capacity of not only children engaged in the same occupation, but those working in different occupations. A group of children were rated and it was found "that ratings of children on this scale accorded extremely well with general estimates of industrial capacity as given by judges with most experience." Results further demonstrated that the composite mental age is the best indication of industrial efficiency, and they gave further proof of the close relation of the Porteus maze test age to industrial aptitude.

This volume by Porteus well deserves the attention of those interested in clinical psychology and in problems of mental testing. The wide experience of the author makes it possible for him to contribute much in the general discussion of the problems in both fields. His criticism of the Stanford I.Q. as a definition of feeblemindedness and of the plan for making the Binet the touchstone of reliability and validity for all other tests are examples in point. In the interpretation and discussion of specific conclusions to be drawn from scientific investigations the author does not, however, appear at best advantage. There is a tendency to value too highly difference of .05 or 1.0 in *r*. There is a tendency to draw broad conclusions on differences in averages which do not appear significant to the reviewer. There are also weaknesses in method which might have been stressed more emphatically.

From the point of view of organization there is much to be sought for in the way of improvement. The content of the individual studies are related in so far as they come within the general field of studies of mental deviations, but there is no attempt to weave the subject matter of the individual studies into a unified point of view. The statement such as "it is ridiculous to think that the mere statement of mental age gives us any very useful information about the special industrial aptitudes and interest of a defective" in one study vies with the highly laudatory statement about the Porteus maze and the composite mental age in predicting industrial adaptability in other studies. However, this defect is probably counterbalanced by the greater accessibility of the studies in the new form and by the repeated statement of Porteus they represent only a beginning, and not the final word, in the investigations of mental deviations.

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BENNETT, HENRY EASTMAN. *Psychology and Self-Development.* Boston: Ginn. Pp. viii+296.

This book purports to contain: "(1) That which will function directly in increasing the student's capacity as a learner; (2) that which will afford the most useful basis for a course in teacher training; (3) that which will best meet the needs for a first course in college psychology." In addition the author wishes to interest the student in a further pursuit of the subject and help him reconcile his scientific knowledge and religious belief.

The style and language are very popular and easily read. In conformity with his statement of the purpose of the book, the author begins with a chapter on "The Art of Learning"; however, he tells us nothing of importance concerning this art, except how to take notes on lectures and readings. He omits most of the things usually contained in a discussion of the learning process. The second chapter tells us that the basis of learning is the strengthening of synapses by means of pleasurable responses. The thrill of pleasure is "Nature's O.K. on the particular combination of synapses involved. . . . It seems to both put force into the current, thus making stronger the synaptic bridges of this particular pathway, and to afford pleasure, which is nature's way of getting the act repeated." We may overlook the mixed metaphor, but to talk of "Nature's O.K." seems out of place in a scientific textbook.

In the chapters on instinct and habit, the instincts are compared to the unharnessed forces of nature, such as winds, streams, and the energy buried in coal, petroleum, and gasoline; habits are like the machines through which these energies are utilized. The validity of this comparison seems very questionable. The classification of instincts and discussion of habit as a whole is rather superficial. There are the usual chapters on sensation, perception, concepts, etc., written from the introspective point of view and in very popular language. The concluding chapters on "The Whole Mind," "The Disorganized Mind," and "The Powers of a Trained Mind," are philosophical rather than psychological. The nearest the author comes to a definition of psychology is the statement: "All mental life is but some form of unifying, integrating or joining together, and psychology studies the kinds and qualities thereof." This definition is characteristic of the nature of the whole book.

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PRESCOTT, FREDERICK CLARKE. *The Poetic Mind.* N. Y.: Macmillan, 1922. Pp. xx+308.

Mr. Prescott finds that the operation of the poet's mind lies halfway between the provinces of literature and psychology, and he attempts to treat of it from the point of view of literature. Of the sixteen chapters of the book, the first two are largely occupied with definition and example. Mr. Prescott then devotes a chapter to man's two modes of thought, and goes on to an extended treatment of the poetic imagination on the basis so laid down. Two more chapters are devoted to the unconscious mind and to the desires and emotions in poetry. After a consideration of these formative elements, in the latter part of the book he studies the working out in poetry of the poetic imagination, treating, for example, of the use of symbols and figures, and of the utility of poetry.

The main points in Mr. Prescott's book may perhaps be summarized in an attempt to find from his work answers to the following questions: What is poetry? What does the poet do in making it, and how is the poet's mind different from that of the ordinary man? Mr. Prescott gives his working definition of poetry thus: "These are the two tests then—the presence of imagination in the substance and of rhythm in the form; whatever satisfies these tests will be included as poetry in the following discussion" (p. 9). The thought of the poet is different from that of the ordinary man of action, and is closely allied to that of the dreamer. He, too, seeks the deeper sources of moral wisdom which our conscious waking mind cannot ascertain, and by this visionary thought he produces poetry. Mr. Prescott's exposition then deals with the two kinds of thought which he finds in man: associative thought and voluntary or purposive thought. The poetic vision, like the ordinary dream, is concrete, while at the same time it derives its material only indirectly from the senses; this vision is the source of true poetry.

Mr. Prescott admits that no hard and fast line may be drawn between this free, visionary thought and the purposive thought of daily life, but he bases the greater part of his explanation of the poetic imagination on the former. It is the primitive manner of thought, to which man reverts when his mentality is insufficient to cope with a situation. The mental insufficiency of the poet is due to the magnitude of his subject, not to a naturally weak mind; so, "voluntary thought being useless, the only resort is purposeless or merely associative thought" (p. 74). Mr. Prescott finds that this

mental operation is often partly unconscious. "The unconscious is the deeper and more vital mind, of which the intellect is a specialization—a tool or instrument employed for practical purposes" (p. 90) and the poet has the power of utilizing this unconscious material. On analysis, his thought is found to consist of concrete images, which correspond to reality and also to the poet's wishes, desires, or aspirations, which in turn are "the motive force and stand at the beginning of the poetic process" (p. 129). Emotion always accompanies them. Mr. Prescott finds, then, that the operation of ordinary thought and that of the poetic mind may be differentiated as follows: "In each case the desires are the originating or motive element; in the first they suggest a conscious end, which will presumably lead directly or indirectly to their satisfaction, and this end, established by the will, governs the imaginative presentations; in the second the desires work their own will, and find direct satisfaction in the pictures presented by the imagination, which are lawless except in so far as they are bound thus to furnish satisfaction to the desires which prompt them. This is the faculty of imagination" (p. 144). From this point on Mr. Prescott gives a rather technical development of his theme; he treats of the external and internal elements of the imagination, of its recent and early sources, of condensation and displacement. The method of poetical composition is considered, and finally the utility of poetry.

It is notable that Mr. Prescott proceeds in his volume by a method of analysis and example. He emphasizes the parallel of dream and poetry by quotations from authorities, for instance. From the angle of literature his use of this method is pronounced, and the poets themselves furnish his evidence. "The poets are in general excellent psychologists, and where the question concerns the working of their own minds they are the best. Psychology must obtain most of its facts ultimately from introspection. If then . . . the poet's mind is to be investigated, the poets are obviously in sole possession of the most important data" (p. x).

Given, then, Mr. Prescott's method and his thesis, can it be said that in this book, which is clearly and interestingly written, he has adequately treated of the operation of the poet's mind? It must be noted here that Mr. Prescott places among his basic assumptions various Freudian principles—wish-fulfilment in dreams and poetry, for example—which would not meet with universal acceptance. His conception of the unconscious and his interpretation of the mechan-

ism of the processes of imagination (condensation, displacement, the use of symbols, etc.) are also open to controversy. But perhaps a more fundamental difficulty to conviction of his thesis lies in his primary analysis of the two modes of thought. Mr. Prescott quotes authority for his distinction between purposive and visionary thought, but finds that there is probably a difference in degree only between the two. On the other hand, his whole exposition of the poetic mind seems to depend upon the existence of a distinct, visionary thought-process, different in kind from ordinary thinking. This assumption presents difficulties to the reader. Mr. Prescott's acceptance of the evidence of the poets themselves in regard to psychological truths also makes his conclusions seem of doubtful validity. Not everyone will be willing to agree with him that the poets are in general excellent psychologists, nor will everyone grant that "psychology must obtain most of its facts ultimately from introspection." As Mr. Prescott bases many of his arguments on this more or less uncertain evidence, it is doubtful whether the reader will be convinced of the conclusions he draws in connection with the psychological study of the poet's mind. From the point of view of literature, Mr. Prescott's book may be of greater interest.

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BAUDOUIN, C. *Studies in Psychoanalysis*. N. Y.: Dodd, Mead, 1922. Pp. xxiv+508.

The attitude of the French mind towards psychoanalysis has been characterized, in general, by indifference or skepticism. This has been due, among other things, to the lack of rapport between the new and the older psychologies, and to the turbidity and to the presumption of some of the psychoanalytic teachings. Baudouin's aim is "an unceasing collaboration between autosuggestion and psychoanalysis" (p. 16), and he presents in this book the results of his work. In addition, he attempts an exposition of psychoanalysis for the French reader, and searches "for points of contact between psychoanalysis and ordinary psychology" (p. 4). Despite the claims of the translators, the beginner will be handicapped by a lack of previous orientation, even in the case histories, which occupy two-thirds of the book. These histories, while incomplete, are engagingly written. By their perusal, according to the translators, the beginner "will be able to enjoy a course of Psychoanalysis without Tears" (p. xv). For the

orthodox analyst, they will probably be without depth as well; but Baudouin should not fail in his desire to "interest experts."

The theoretical part of the book is very worthwhile, and contains much stimulating discussion that is presented with admirable clarity. Baudouin, oddly enough, deals more successfully with his consideration of psychoanalysis, as he understands it, than with his main thesis: the conjoined use of psychoanalysis and suggestion. In the latter case he generalizes extensively, and there is a notable lack of concrete explanation. (An example of the few exceptions to this is the statement [p. 410]: "While practising [psychoanalysis], I faced the subject; for the practice of [suggestion] I stood behind her.") Indeed, we are informed that a knowledge of the "law of subconscious teleology" (*i.e.*, when the end has been suggested, the subconscious finds means for its realization) "has led Coué to substitute to an increasing extent *positive* and *general* suggestions for *negative* and *particular* suggestions" (p. 134). Thus, Baudouin believes, the objection of the psychoanalysts that suggestion merely leads to further repression, is obviated.

Suggestion probably enters into all psychoanalytic practice to some extent. Many psychoanalysts recognize this frankly and attempt to minimize the extent; others minimize even the probability. Baudouin's desire to "guide" suggestion intelligently is a worthy one; perhaps he does so in practice, but he leaves many pertinent questions unanswered here. The translation is excellent.

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NOTES AND NEWS

THE Eighth International Congress of Psychology will be held at Groningen, Holland, from September 6 to 11, 1926, under the presidency of G. Heymans. Psychologists who, having received no invitation, wish to attend the Congress, are requested to apply to the First Secretary, Professor Dr. F. Roels, 86 Maliebaan, Utrecht, Holland.

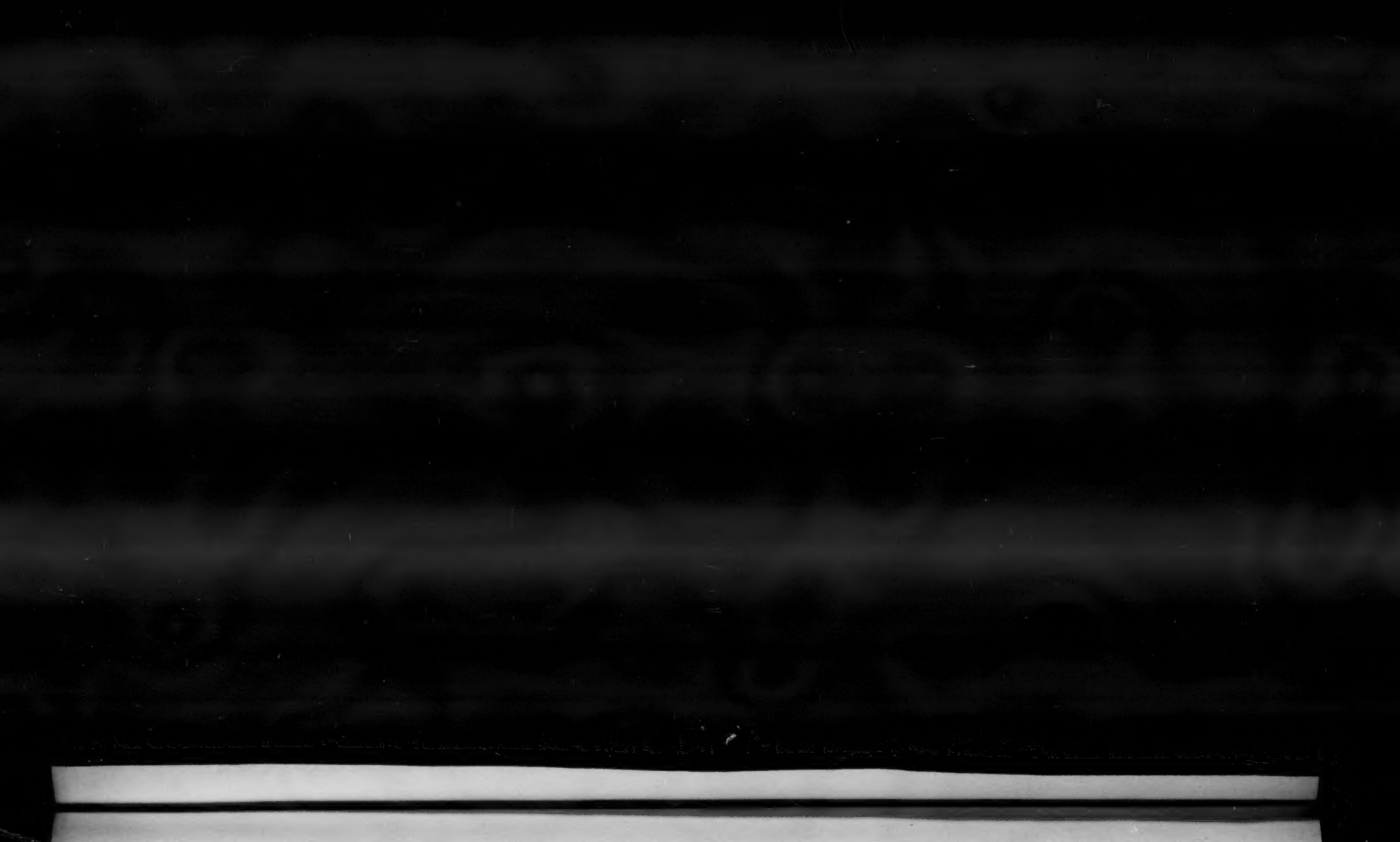
DR. HARRY DEXTER KITSON, of the University of Indiana, has been appointed professor of education in Teachers College, Columbia University.

PROFESSOR HENRY H. GODDARD, of Ohio State University, sailed for Honolulu on May 13, to deliver a series of lectures under the auspices of the University of Hawaii.

DR. ENGLISH BAGBY, assistant professor of psychology at Yale University, has been appointed associate professor of psychology at the University of North Carolina. Here he will be in charge of research problems in student personnel in addition to his teaching.

PROFESSOR COLEMAN R. GRIFFITH, of the University of Illinois, has been awarded a fellowship by the John Simon Guggenheim Memorial Foundation for research in child psychology, principally at the University of Giessen.

PROFESSOR EDWARD L. THORNDIKE, of Teachers College, Columbia University, has been awarded the Butler gold medal, given every five years by Columbia University for the most distinguished contribution to philosophy or to educational theory, practice or administration, for his contribution to the general problem of the measurement of human faculty and to the application of such measures to education.

AT the University of Pennsylvania, Dr. M. S. Viteles has been promoted to assistant professor of psychology.

IN an article published in the *Psychological Review* for May, 1924, entitled "Measurement of Intelligence," there was a reference to future articles of the series. It was intended at the time to publish such articles, but the material was highly technical and much more extended than had been anticipated. It therefore seemed better to discontinue the series. The material is being published as a monograph entitled "Measurement of Intelligence."